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Face Recognition and Crime Detection

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Abstract

Face recognition has emerged as a pivotal technology in the fields of security and law enforcement. This project explores the integration of face recognition systems with crime detection databases to identify suspects, repeat offenders, and missing individuals in real-time. By leveraging advanced machine learning and deep learning techniques—particularly Convolutional Neural Networks (CNNs)—the system captures and compares facial features against a known criminal database. The proposed solution aims to enhance surveillance systems, reduce manual investigation efforts, and support authorities in proactive crime prevention. With high accuracy and real-time identification capabilities, face recognition can revolutionize modern policing and contribute significantly to public safety.

Introduction

With the rapid development of artificial intelligence (AI) and image processing, face recognition has gained widespread application in domains such as access control, financial verification, and surveillance. In law enforcement, identifying suspects manually from CCTV footage is time-consuming and prone to human error. As a result, automated face recognition has become an essential tool for enhancing investigative capabilities.

Facial recognition technology works by extracting unique features from a person's face—such as distance between the eyes, jawline shape, and nose width—and comparing them to a pre-stored database of known faces. These comparisons are powered by deep learning models that improve in accuracy over time as more data is processed.

Integrating facial recognition with crime detection systems allows real-time monitoring in sensitive locations like airports, railway stations, banks, and public events. Suspects can be flagged automatically, and alerts can be raised without manual intervention, helping authorities to take timely action.

This project aims to build a face recognition system using Python, OpenCV, and deep learning models (CNN, FaceNet, or Dlib), connected to a criminal face dataset. It will identify faces from live camera feeds or images and determine if the individual matches a profile in the crime database.

Literature Survey

1. Viola-Jones Algorithm (2001): Paul Viola and Michael Jones introduced a real-time face detection framework using Haar feature-based cascade classifiers. It became a foundational model for early facial recognition systems.

2. DeepFace by Facebook (2014): DeepFace uses a 9-layer deep neural network and achieved 97.35% accuracy in face verification tasks. It was one of the first models to reach near-human performance.

3. FaceNet (Google, 2015): FaceNet introduced a model that maps facial features into a compact Euclidean space, making it effective for recognition and clustering tasks. It remains one of the most used models in face verification systems.

4. Dlib Library: The Dlib library uses a 5-point or 68-point facial landmark detector and ResNet-based models. It is widely used in real-world facial recognition systems for its speed and accuracy.

5. OpenFace (CMU, 2016): OpenFace is an open-source deep learning model designed for face recognition. It provides accuracy close to FaceNet while being more accessible and easier to integrate into lightweight applications.

6. Crime Detection Using Face Recognition (R. Suresh et al., 2019): This paper proposed the use of face recognition integrated with crime records to identify suspects in real-time. The system was tested using CCTV footage and produced reliable outputs for controlled environments.

7. Surveillance-Based Facial Recognition (Zhao et al., 2017): They explored the use of face recognition for surveillance video and proposed improvements for handling occlusions and low-quality frames.

8. Deep Learning for Law Enforcement (Patel et al., 2020): The study evaluated multiple deep learning algorithms in identifying suspects from police databases and recommended CNN-based approaches for scalability.

Proposed Method

The proposed system uses a deep learning-based facial recognition pipeline integrated with a crime database to automate suspect identification:

1. **Dataset Collection:** A dataset of known criminal images is created. These may be gathered from official records or open-source databases (e.g., CelebA, LFW modified for crime simulation).
2. **Preprocessing and Feature Extraction:** Facial images are preprocessed—converted to grayscale, normalized, and resized. Facial landmarks are extracted using Dlib or MTCNN for alignment. CNN or FaceNet is used to extract unique facial embeddings.
3. **Model Training and Classification:** A classification model (e.g., KNN, SVM, or triplet-loss-based CNN) is trained on embeddings of known faces. For real-time recognition, embeddings of incoming faces (from webcam or CCTV) are compared with the database using cosine similarity or Euclidean distance.
4. **Real-Time Detection:** When a match is found with confidence above a certain threshold, the system flags the individual and raises an alert. Logs are maintained for future analysis.
5. **GUI Integration and Alerts:** A user interface is provided to view real-time camera feeds, detected faces, and matching status. Alerts are generated through email, SMS, or system notifications for police monitoring.

Result

Conclusion

The integration of face recognition with crime detection presents a promising solution for modern law enforcement and surveillance systems. By automating the process of suspect identification, the proposed system reduces manual effort, increases accuracy, and enables timely intervention. Leveraging CNN-based models and facial embeddings ensures that the recognition is both fast and reliable. Future enhancements may include integration with national databases, multi-camera systems, and emotion or behavior analysis for more proactive security measures.

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